

# **4**

## **OPERATION PROCEDURE**

## 4. OPERATION PROCEDURE

### 4.1 INTRODUCTION

This chapter provides detailed operating procedures for using the Compact Metal Vapour Laser. The next section (4.2) contains descriptions of the controls and indicators. It is advisable to become familiar with the functions of the controls and indicators before attempting to switch on the laser. **IT IS ALSO STRESSED THAT CHAPTER 2 (SAFETY) MUST BE READ BEFORE ANY ATTEMPT IS MADE TO OPERATE THE LASER.** The final section (4.3) contains detailed procedures for switching the laser on and off. If any fault occurs during operation of the laser, reference should be made to Chapter 6 (Fault Finding).

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## 4.2 CONTROLS AND INDICATORS

The numbers preceding each control or indicator description refer to the corresponding numbers on the equipment illustrations.

### 4.2.1 Laser Head Controls: The High Voltage End

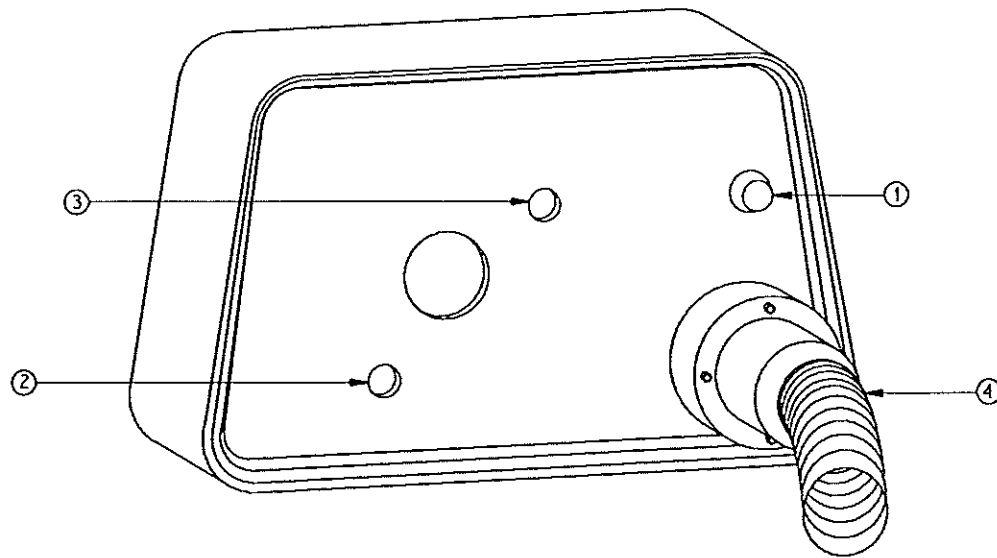


Figure 4.1 The high voltage end of the laser

NO.	CONTROL/INDICATOR	DESCRIPTION	FUNCTION
1	Laser emission indicator	Lamp	Lights when power supply connected to show laser emission possible.
2	Rear mirror adjustment (horizontal)	Set screw	Laser cavity alignment: horizontal adjustment of rear mirror.
3	Rear mirror adjustment (vertical)	Set screw	Laser cavity alignment: vertical adjustment of rear mirror.
4	Umbilical cable		Supplies services to laser head.

### 4.2.2 Laser Head Controls: The Laser Output End

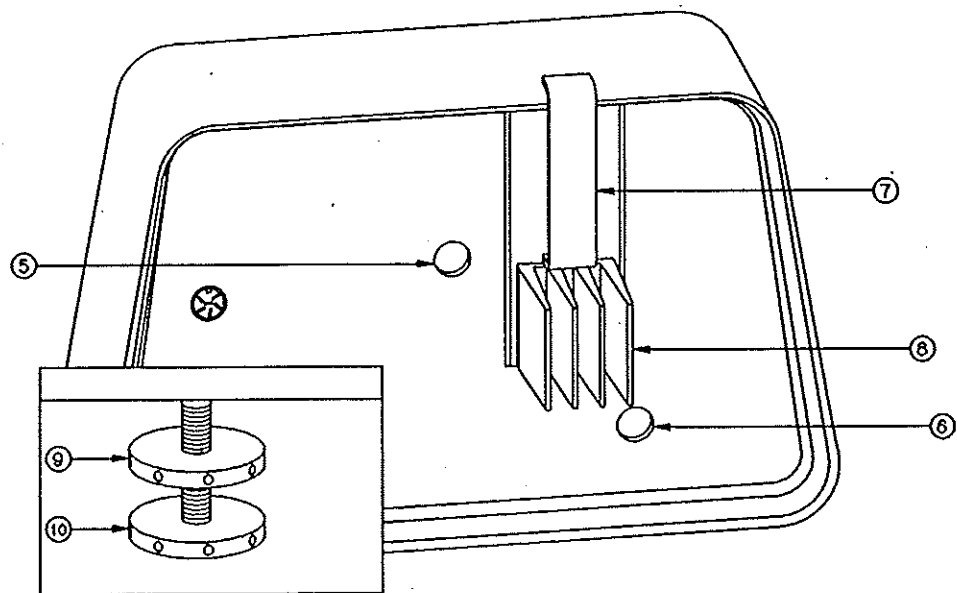


Figure 4.2 The output end of the laser head

NO.	CONTROL/INDICATOR	DESCRIPTION	FUNCTION
5	Front mirror adjustment (vertical)	Set screw	Laser cavity alignment: vertical adjustment of front mirror.
6	Front mirror adjustment (horizontal)	Set screw	Laser cavity alignment: horizontal adjustment of front mirror.
7	Beam stop	Heat sink with handle: fitted with ball catch	Completely blocks laser output. Shutter is opened by lifting handle.
8	Laser aperture	3.5 cm hole	Allows laser output.
9	Foot locking nut (1 of 4)	Metal ring	Locks adjustable foot in position.
10	Adjustable foot (1 of 4)	Metal ring	Levels laser head.

### 4.2.3 Power Supply & Control Unit (PSU) Controls

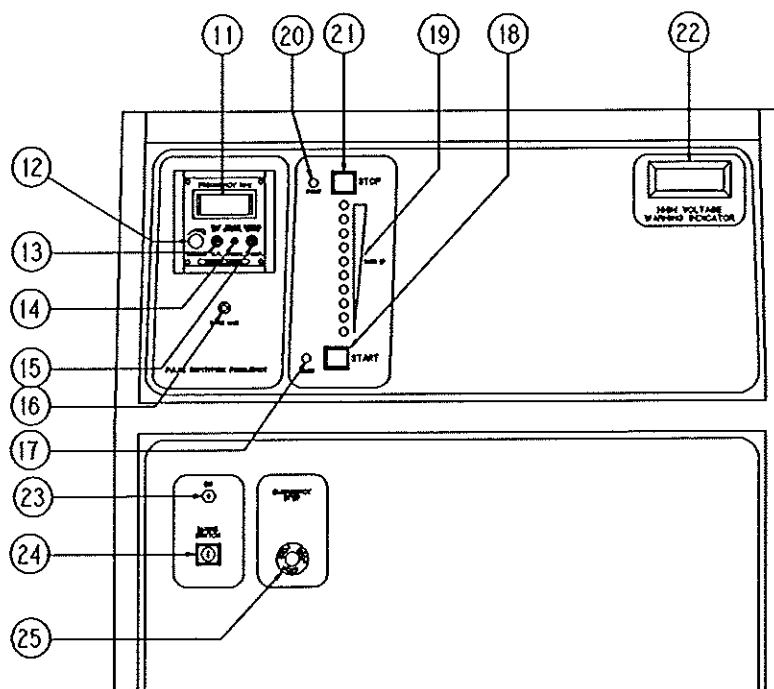


Figure 4.3 Top and front panels of PSU

NO.	CONTROL/INDICATOR	DESCRIPTION	FUNCTION
11	Frequency meter	Liquid crystal display	Shows pulse repetition frequency (PRF) in kHz.
12	Frequency control	Knob	Allows selection of PRF.
13	Sync out	BNC socket	Gives 15V output pulse synchronised to laser pulse.
14	INT/EXT/Auto-Sync Select	3-position toggle Switch	Allows selection between internal/external/Auto-Sync (centre position) trigger pulse source
15	EXT input	BNC socket	Accepts 2-20V pulses of 0.5-10 $\mu$ s duration to trigger firing of laser.
16	OUT OF RANGE indicator	LED	Indicates that a non-optimum PRF setting has been selected (see section 7.4).

NO.	CONTROL/INDICATOR	DESCRIPTION	FUNCTION
17	READY indicator	Yellow LED	Indicates all interlocks OK and START switch enabled.
18	START switch	Push button	Activates start sequence.
19	WARM UP indicators	10 Yellow LEDs	Indicate progress of the warm up cycle. The 1st LED indicates warming of the thyatron. The 2nd LED indicates that the high voltage circuits (laser discharge) are activated. Laser output may occur at any time after the second indicator is lit. Time taken depends on previous state of laser
20	FAULT indicator	Yellow LED	Indicates that a fault has been detected in the high voltage circuit. (The LED can also flash, depending on the fault condition. Refer to Chapter 6 for details.)
21	STOP switch	Push button	Deactivates high voltage circuit.
22	HIGH VOLTAGE WARNING indicator	Illuminated light	Shows high voltage circuit is active - laser emission is possible.
23	POWER SUPPLY ON indicator	illuminated white light	Indicates power supply engaged at key switch.
24	System key MAIN SWITCH	Key switch	Engages power supply. Key cannot be removed until power is switched off.
25	EMERGENCY STOP switch	Red locking mushroom button	Allows rapid power off in emergency - disengages main contactor. Note: Power supply voltage is still present in the PSU.

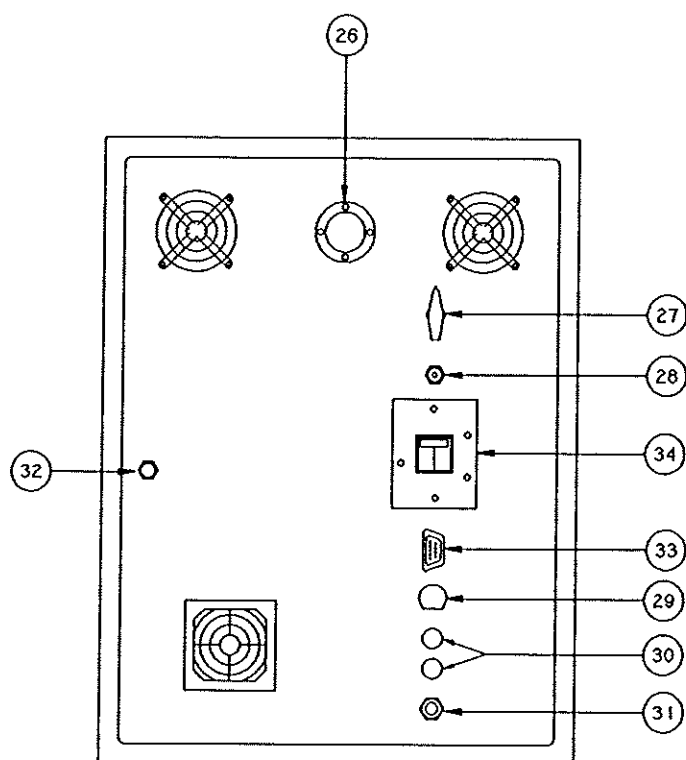


Figure 4.4 Rear panel of the PSU

NO.	CONTROL/INDICATOR	DESCRIPTION	FUNCTION
26	Umbilical cable		Carries services to laser head.
27	Gas supply select switch	T-tap	Allows internal or external buffer gas cylinder to be selected.
28	External gas port	1/4 inch "Swagelock" * compression fitting	Allows connection of external supply of buffer gas to system.
29	Remote interlock	3-pin receptacle with mating plug	Permits inclusion of external interlock switches.
30	Power supply fuse	Screw fit fuse holder	15A fast blow fuse in power line.

\* "Swagelock" is a trademark of the Crawford Fitting Co.

Note: Lasers for certain destinations may be fitted with 2-pole 16A circuit breakers in place of, or in addition to, the power supply fuse.



NO.	CONTROL/INDICATOR	DESCRIPTION	FUNCTION
31	Power supply cable lead	3-core 15A cable	Connects system to power supply (208/220/240 VAC).
32	High Voltage Power cut-out / reset	Push button	15A circuit breaker - limits current in primary windings of high voltage transformer.
33	External Meter readout	9-Way "D" Connector	Output socket for voltage, current and auxiliary current meters

### 4.3 STANDARD OPERATION

This section describes in more detail the operation procedures for the Compact laser. A brief summary of these is given in Chapter 3. The instructions cover only the basic procedures for switching on and off the laser.

#### 4.3.1 Running Up the Laser from Cold

**Note:** In normal use, the gas supply should remain connected to the laser. Unless the laser is to be shut down for an extended period, the gas supply should not be turned off. The gas supply line pressure is monitored by an internal interlock circuit. If the gas cylinder is empty or not connected, the laser will not start. If the laser is operating when the gas pressure fails, this interlock will shut the system down.

- 1) Check that power is connected to the laser.
- 2) Check that the Condition Timer is set to "Condition" and that the manual gas controls are both in the normal (up) position.
- 3) Insert the system key and turn the key switch on. After 7 seconds, if all the interlock conditions are met, the READY indicator will light up. If the interlocks have been overridden for servicing, the READY indicator will flash.
- 4) Press the START switch. The first (i.e. the bottom) WARM UP LED will illuminate. There will then be a delay of approximately 7 minutes while the thyatron reaches operating temperature, before the second WARM UP LED is lit and the laser discharge starts. After this period, the remaining WARM UP LEDs will be lit in succession as the laser approaches operating temperature. Normally the laser is ready for use before the tenth WARM UP LED is illuminated. The total time taken for warming up depends on the time elapsed since the laser was last switched off. Warm up from cold will typically take approximately 45 minutes.

**Note:** If the Dirt Monitor interlock goes out and turns the laser off then wait until the interlock resets itself and then press the START switch again.

#### 4.3.2 Switching Off the Laser

- 1) Press the STOP switch. The ten WARM UP LEDs go out, but the READY LED remains on.

In normal use, the gas supply should remain connected to the laser. After approximately eight hours, the gas pressure in the laser reaches a factory preset level which ensures reliable operation during the subsequent start-up sequence. Power to the laser is NOT required for this automatic gas filling process.

- 2) The cooling fans will continue to run for a timed period to prevent the equipment from overheating. Wait until the fans stop running (about 20 minutes) and then turn off the system key switch.

Note: The cooling fans will continue to run for a timed period to prevent the equipment from overheating. The laser may now be disabled at any time by turning off the key switch and removing the key. However, as the cooling fans will therefore be powered from the internal emergency supply, it is not advisable regularly to turn off the key switch within 30 minutes of pressing the STOP switch

#### 4.3.3 Running Up the Laser from Warm

The procedure for switching on the laser from warm is exactly the same as the switch on procedure from cold, described in Section 4.3.1. The only observable difference will be the duration of the warm up period.

- 1) Make sure the key switch is in the ON position: the READY LED should be on.
- 2) Press the START switch: the 7 minute delay for the thyatron heater will still occur, but the length of time for the remainder of the warm up period will be shorter, depending on how long the laser has been switched off.

#### 4.3.4 Running Up the Lasers After an Extended Shutdown Period or Service Procedure

Difficulty may be experienced when running a laser up from cold after a long shutdown period, or if the laser vacuum envelope has been opened for more than a short time. This will often cause the Dirt Monitor interlock to trip. The laser should be restarted using the same procedure as in 4.3.1. If an extended period of high gas flow is required, longer than that automatically provided by the Condition Timer, the manual gas override switches in the PSU should be switched down; this will enable the laser to run at a higher than normal flow rate. WHEN LASER EMISSION FIRST OCCURS, THE GAS SWITCHES SHOULD BE RETURNED TO THEIR NORMAL POSITIONS. This is important as extended laser operation at the higher gas flow rate will significantly reduce the lifetime of the copper charge.

#### CAUTION:

WHEN STARTING THE LASER FROM WARM, LASER EMISSION MAY OCCUR AT ANY TIME DURING THE WARM UP PERIOD INDICATED BY THE WARM UP LEDS.

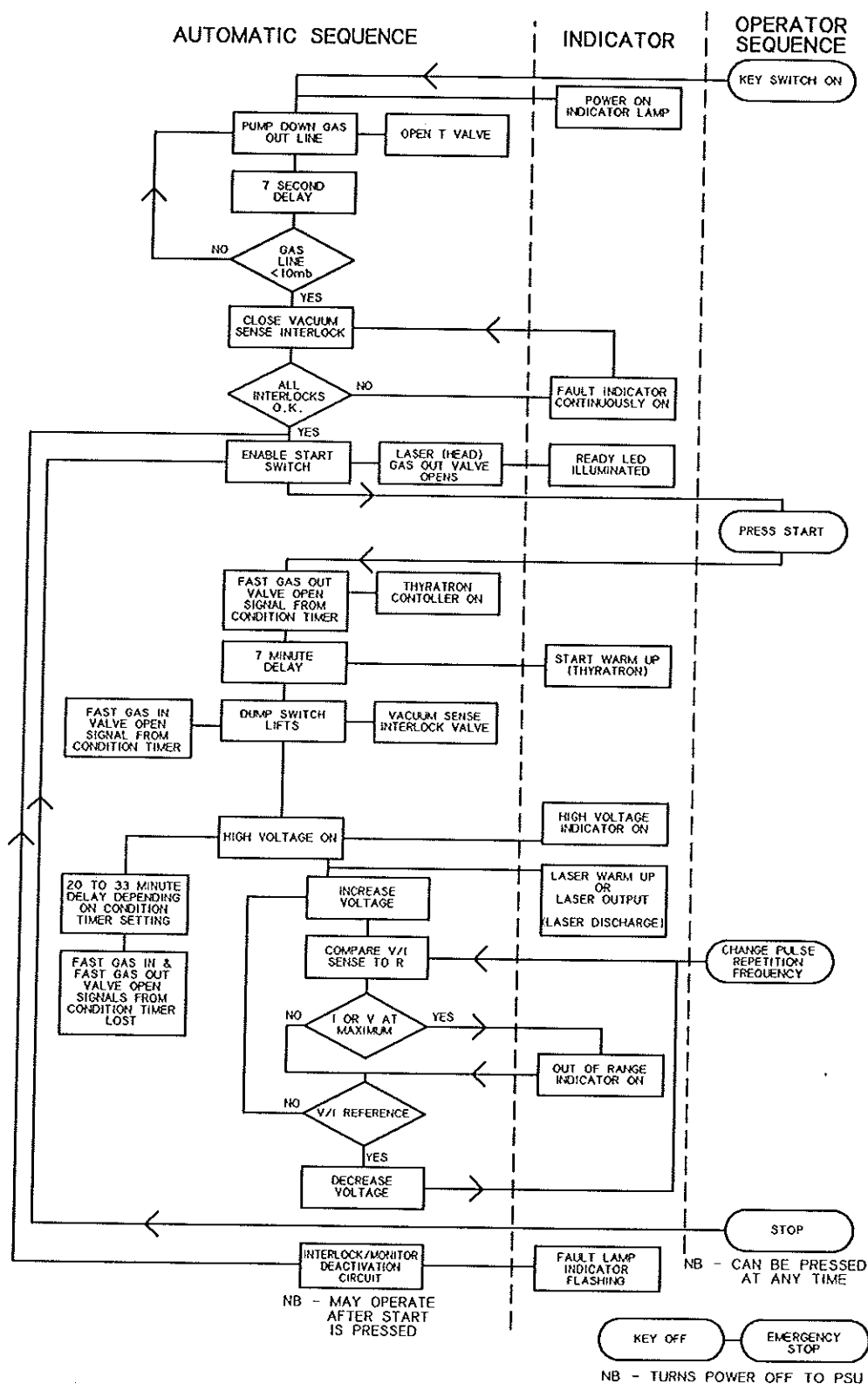


Figure 4.5 Laser operation flow chart